

REMARKS

The Claims

Claims 1-7 are presently pending in this application.

The Invention

An etching solution of the present invention includes hydrofluoric acid, nitric acid, and hexafluorosilicic acid, the concentration of the hexafluorosilicic acid being 10% to 40% by weight based on the weight of the etching solution. Etching solutions according to the present invention are useful for etching a silicon substrate and providing, e.g., a silicon wafer having improved flatness and gloss, at least in part because the claimed etching solution can be selected to have an optimal etching speed and etching rate, without runaway of the etching reaction.

The Rejection of the Claims

Applicants note with appreciation the withdrawal of the previous rejection of claims 1-7 under 35 U.S.C. 102(b) as being anticipated by Satoro *et al.*, (JP 11194120).

Claims 1-7 were rejected as unpatentable over Lee (US 6,284,712) in view of Uchida (US 5,307,296). Applicants traverse this rejection.

Although the Examiner has not fully reiterated this rejection in the present Office Action, the Examiner states that "Applicants' proposed unexpected results . . . are insufficient to distinguish over the applied art because the units of etching stability are based on subjective criteria." Office Action at page 5. Applicants disagree.

The criteria set forth in the Declaration Under 37 CFR 1.132 filed with a previous response ("the Declaration") are easily understandable. Indeed, it is Applicants' view that such evaluations are ordinarily used and can be readily understood by one of ordinary skill in the art. However, for the Examiner's convenience, a description of the methodology will be supplied.

For each criterion ("Surface Irregularity", "Degree of Flatness", "Gloss", and "Surface Roughness"), a value for the best result and for the worst result are defined, and the range between the best and worst result is divided into four equal parts, ranked as 4, 3, 2, and 1 (with 4 being best and 1 being worst).

The etching stability of a silicon wafer is usually evaluated by viewing the scores for "Surface Irregularity", "Degree of Flatness", "Gloss", and "Surface Roughness" in their totality, although the different scores may be accorded different weight according to their relative importance. For example, in the Declaration, Table 2 provides ranks shown as \circ and \diamond . Each of these ranks has a total score of 14 (that is, the evaluations for "Surface Irregularity", "Degree of Flatness", "Gloss", and "Surface Roughness" have a total value of 14). Comparing the ranks shown as \circ and \diamond as described in Table 2 of the Declaration, it can be seen that "Gloss" is more important than "Degree of Flatness"; while both \circ and \diamond have a total score of 14, the higher score for "Gloss" in rank \circ means that a solution rated as \circ is practically usable, while a solution rated \diamond is limited, although stable, because the etching speed is low.

In Experiment 1, the grade of etching stability of the solution containing greater than 40% hexafluorosilicic acid was shown as $\triangle \sim \times$. As shown in Table 2 of the Declaration, when each of the four criteria receives a score of 1, then the grade is \times . When score for "Surface Irregularity" is 2 and the score for each of the remaining three criteria is 3, then the grade is \triangle . Thus, the scores for the solution of Experiment 1 of the Declaration indicate a grade of etching stability greater than \times but worse than \triangle , and the solution was therefore given a grade of $\triangle \sim \times$. This evaluation would be readily understood by one of ordinary skill in the art.

For at least the above reasons, Applicants submit that the Declaration provides evidence that the claimed etching solution patentably distinguishes the solutions disclosed by the cited references.

The teachings of the Lee and Uchida references have been previously described. It is Applicants' position that neither the Lee reference nor the Uchida reference, alone or in combination, render the claimed invention obvious, and the Examiner has therefore not established a *prima facie* case of obviousness.

Applicants have provided ample support for their position in previous communications. However, Applicants wish to respond to the Examiner's remarks concerning the Declaration Under 37 CFR 1.132 filed with the prior response ("the Declaration").

In the present Office Action (similar to the previous Office Action), the Examiner states that the Declaration

is insufficient to overcome the rejection of claims 1-7 . . . over Lee et al. . . . in view of Uchida . . . as set forth in the last Office action because: the results shown . . . failed to adequately compare applicants' solutions . . . wherein only one concentration of 42.7% by weight H_2SiF_6 that lies outside the range of 10% - 40% by weight H_2SiF_6 was only used to generalize etching solutions containing concentrations of hexafluorosilicic acid greater than and outside 40% are not optimally suited to etching silicon wafers. Applicants further failed to show what is expected if one uses for example, 45%, 50%, 60% . . . etc. by weight H_2SiF_6 ?

Office Action at Section 1. This rejection is traversed.

As previously described (in the prior Response dated January 4, 2006, in the Declaration and in the accompanying remarks), solutions containing concentrations of hexafluorosilicic acid not exceeding 40% (see, e.g., Examples 1-13 of the present specification, and particularly Examples 8-10) were found to be better suited to etching a silicon substrate than was a solution having greater than 40% H_2SiF_6 by weight (for example, the solutions of Examples 1-13, each having less than 40% hexafluorosilicic acid by weight, all have superior grades compared to the solution of the Declaration, which has greater than 40% hexafluorosilicic acid by weight). Applicants have therefore provided evidence for their contention that the claimed solutions (which have 10% to 40% by weight H_2SiF_6) are superior to solutions having greater than 40% by weight H_2SiF_6 . The Examiner's statement that Applicants have not shown "what is expected if one uses or example, 45%, 50%, 60% . . . etc." is inappropriate. In fact, Applicants contend that it may not be possible to

conduct an etching procedure using an etching solution containing hexafluorosilicic acid at a concentration greater than 45%, as discussed below.

To the extent that the Lee reference discusses the use of hexafluorosilicic acid in a mixed acid etching solution, Lee mentions the use of a solution in which hexafluorosilicic acid is used in a saturated concentration. While the saturated concentration of hexafluorosilicic acid is not definitely known to Applicants, it seems to be greater than 42.7% and is presumed to be about 45%. It is clearly difficult, if not impossible, to conduct comparative experiments in which the concentration of hexafluorosilicic acid is 50%, 60%, or greater, as suggested by the Examiner.

However, Applicants have shown that a concentration of hexafluorosilicic acid of 42.7% renders the resulting solution inferior to solutions having concentrations of hexafluorosilicic acid in the claimed range of 10%-40%. Even when the concentration of hexafluorosilicic acid was 34.8% (as shown in Example 9 of the specification), the resulting solution was superior to the solution having a concentration of hexafluorosilicic acid outside the claimed range. Thus, Applicants have shown that etching solutions containing the claimed amount of hexafluorosilicic acid are unexpectedly superior to solutions having greater the claimed amount of hexafluorosilicic acid.

Applicants have come forward with evidence to support their position (e.g., in the specification and the Declaration); the Examiner cannot simply assert that Applicants have not supplied data for every possible solution. Applicants are not required to provide such data. See, e.g., MPEP 2144.08(II)(B): "An exemplary showing may be sufficient to establish a reasonable correlation between the showing and the entire scope of the claim, when viewed by the skilled artisan" (citations omitted). As also provided by the MPEP, "[u]sually, a showing of unexpected results is sufficient to overcome a *prima facie* case of obviousness." MPEP 2144.08(II)(B), citing *In re Albrecht*, 514 F.2d 1389, 1396, 185 USPQ 585, 590 (CCPA 1975). Thus, even if the Examiner has established a *prima facie* case of obviousness (which Applicants dispute), Applicants' showing has overcome that *prima facie* case.

Reconsideration and withdrawal of the rejection is proper and such action is requested.

Claims 1-7 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Satoro *et al.*, (JP 11194120). This rejection is traversed.

While the Examiner concedes that Satoro fails to disclose the claimed solution in which the concentration of concentration of hexafluorosilicic acid is between 10% and 40% by weight, the Examiner nevertheless states that "the reference illustrates that the concentration of each acid [in the etching solution] is an optimized variable." Office Action at Section 4. Applicants do not agree.

As discussed in a previous response, the Satoro reference, as understood by Applicants, is directed to methods and apparatus for *analyzing* mixed acid solutions, not to novel etching solutions themselves (see, e.g., the Abstract). The Satoro reference describes analysis of a mixed acid solution which, after etching treatment of a silicon substrate, would include some hexafluorosilicic acid (see, e.g., Satoro at paragraphs 16-18).

The Satoro reference does not disclose any specific solutions having the claimed amounts of hexafluorosilicic acid, nitric acid, and hydrofluoric acid. The Examiner points to paragraph 48, in which Satoro discloses a solution which, after analysis, was found to contain 34.5% nitric acid, 7.5% fluoric acid, 20.9% acetic acid, and 4.6% hexafluorosilicic acid, by weight. In this case, the amount of hexafluorosilicic acid is less than 10%, which is outside the claimed range of 10 – 40% by weight recited in the solutions of the invention as presently claimed (15-40% according to claim 2).

In fact, the concentration of hexafluorosilicic acid at paragraph 48 of Satoro (4.6%) is similar to the concentrations disclosed in Comparative Examples 1 and 2 of the present specification (i.e., 5.4% and 3.2%). In each of those Comparative Examples, the resulting solution was found to be inferior to the solutions containing between 10% and 40% hexafluorosilicic acid, as required by the pending claims.

Indeed, the Satoro reference does not teach the suitability of any particular etching solution for etching a silicon substrate. The reference merely discusses analysis of solutions to determine the concentration of acids therein. Far from teaching that "the concentration of each acid [in the etching solution] is an optimized variable," as suggested by the Examiner, the Satoro reference says nothing at all about the desirability of a solution having the claimed amounts of acids, and, in particular, is silent as to the suitability of an etching solution having the claimed amount of hexafluorosilicic acid. Nothing in the Satoro reference would motivate the skilled artisan to modify the teachings of Satoro to arrive at the claimed invention.

Accordingly, Applicants respectfully submit that the Satoro reference does not teach or suggest a solution according to the present invention, and therefore cannot, and does not, render obvious the presently-pending claims.

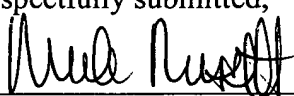
Reconsideration and withdrawal of the rejection is therefore appropriate and the same is requested.

CONCLUSION

It is respectfully submitted that the present application is in condition for allowance. An early consideration and notice of allowance are earnestly solicited.

In the event that an extension of time is required for this response to be considered timely submitted, the undersigned hereby conditionally petitions for any extension of time necessary. It is not believed any additional fees are required; however, if an additional fee is required, or if an overpayment is made, please charge/credit our deposit account 04-1105.

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